# Space Weather Technical Forecast

Issued on Monday, 01 November 2021 at 12:33 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of further M-class flares. Slight chance of G1/Minor geomagnetic storm interval 3rd and 4th.**

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** There are currently 3 active sunspot regions on the visible disc and solar activity has been Moderate over the past 24 hours, with a few C-class flares and a M1.5 flare observed at 01/0145 UTC. This emanated from AR2887 (Cso / Beta) in the southwest quadrant and produced a CME which is likely to have an Earth directed component but we are awaiting further imagery and analysis at the time of writing. AR2891 (Dac / Beta) remains a compact sunspot group. It is the most complex region on the disc and is the most likely source of future activity. A C3 flare occurred just after 31/0700 UTC from AR2891 generating a CME, analysis of which suggests a possible glancing blow at Earth late on the 3rd or early the 4th November. AR2893 (Hsx/Alpha) remains a mature stable spot in near the northeast limb. Region 2892 in the northwest quadrant faded to plage early in the period.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters, as measured by DSCOVR at L1, were indicative of the waning effects of a CME that arrived just after 31/0900 UTC. Elevated speeds, around 450 km/s, have gradually declined to ambient levels, around 350 km/s. Density values have been average or slightly above average, ranging between 5 and 15 ppcc. Total IMF Bt was initially moderate around 12 nT but reduced to weak levels from 31/1400 UTC (3-8 nT). Its north-south component Bz was predominantly negative through the period, but only ranging between -6 and +5 nT. Phi angle was in a predominantly positive (away from sun) orientation. Resultant geomagnetic activity was mainly Quiet to Unsettled (Kp 1-3) but with Active (Kp 4) intervals recorded 31/1200-1500 UTC and 31/2100-2400 UTC.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level. The high energy electron flux (greater than 2 MeV) was predominantly at background levels with the associated 24-hour electron fluence below the Active (1e8 integrated pfu) threshold, and with 1.22e6 integrated pfu recorded at 01/0000 UTC.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar Activity is forecast to be low over the next 4 days with occasional C-class flares and a chance of further M-class flares.

**Solar Wind / Geomagnetic Activity:** Ambient solar winds are expected to continue through days 1 and 2 (1st and 2nd) with predominantly Quiet geomagnetic activity. On days 3 and 4 (3rd and 4th), the solar wind is likely to become elevated due to CH16/+, possibly combined with weak CME effects. Unsettled to Active intervals are likely on days 3 and 4, and there is a slight chance of G1/Minor Geomagnetic Storms.

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**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to be below the S1 minor storm level, and generally decreasing towards background values. The high energy electron flux (greater than 2 MeV) is forecast to be at mostly background to levels, but may increase to moderate high levels later in the forecast period. The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level, although a rising trend is possible on day 4 (4th).

**Figure 1. Solar Analysis Valid 01/0800 UTC.**

**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

Solar wind speeds are expected to remain at ambient levels for much of day 1 and 2 (1st and 2nd), bringing predominantly Quiet geomagnetic activity, with a chance of Unsettled intervals. On day 3 (3rd) solar winds are likely to become elevated, with Earth expected to make some connection with the high speed stream from positive coronal hole 16, a southern extension of the northern polar crown. STEREO A Mag & PLASTIC data show a significant increase in speeds on 31st Oct, likely under this coronal hole's influence, which would be expected just over three days later at Earth. Also, a CME that departed the sun on 31st Oct may give a glancing blow at Earth on day 3 or early day 4 (3rd and 4th). These two features suggest an increase in solar wind speeds and geomagnetic activity on days 3 and 4 (3rd and 4th), with Unsettled to Active intervals likely and a slight chance of G1/Minor Geomagnetic Storms.

| Geo-Magnetic Storm / Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 5 | 20 | 10 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 31/1628 UTC | Partial | C3 flare | AR2891 | 490 km/s | 03/2100 UTC | Possible glancing blow |

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## Radio Blackouts - X-Ray Flares:

Solar activity is expected to be Low with occasional C-class flares and a chance of further M-class flares. These are most likely to come from AR2891 (Dac / Beta) but A2887 (Cso / Beta) has also continued to prove itself capable. However, this region will reach the southwest limb later in the period.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 30 | 30 | 20 | 20 |
| Very Active | R3 to R5 X Class | No | 5 | 5 | 2 | 2 |

## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is now below S1/Minor storm levels. Generally a declining trend towards background levels is expected to continue through the forecast period, but some small enhancements, similar to that in association with the M1 flare early on the 1st, are possible.

| Radiation Storms | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ S1 | No | 10 | 10 | 5 | 5 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO is currently at mainly background levels, and are generally expected to remain so through the forecast period. However, an increase to moderate/high levels may occur later in the period following the enhancement in the solar wind on day 3 (3rd). Fluence levels are likely to remain below the active threshold (1e8 integrated pfu) through this period, as suggested by latest REFM output, although a rising trend is possible on day 4 (4th).

| GEO Electron Environment | Level ($cm^{-2}\ sr^{-1}\ day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^{8}$ | No | 1 | 5 | 5 | 10 |
| Very Active | ≥ 2 MeV ≥ $1x10^{9}$ | No | 1 | 1 | 1 | 1 |

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